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RESULTS OF THE OXFORD UNIVERSITY EXPEDITION TO BRITISH GUIANA, 1929. HYMENOPTERA, SPECIDAE AND BEMBECIDAE

By O. W. Richards, M.A., D.Sc.

[Read 18th November, 1936.]

With Plate 1.

The following notes are based partly on the material obtained by the Oxford University Expedition (now in the British Museum collection), partly on other material preserved in the British Museum.

Sphecidae.

Ammophila Kirby.

1. *A. abbreviata* (Fabricius, 1805).

(♀ = *guyana* Cameron, 1912; ♂ = *oxystoma* Cameron, 1912).

The types of Cameron's supposed species, which were described from British Guiana, are preserved in the British Museum. I have examined the following further specimens from British Guiana :—♀ (*Rodway*); Essequibo R., Moraballi Creek, ♀ 23 Sept. '29, ♂ 18 Sept. '29 (O.U. Exped.); ♀ N.W. District, Yarikita Passage, Feb. '17 (*G. E. Bodkin*). The two O.U. Exped. specimens were both captured in dark forest.

2. *A. opulenta* (Guérin, 1830).

(= *lobicollis* Cameron, 1912).

The type of Cameron's species, which was described from British Guiana, is preserved in the British Museum. I have examined the following further specimens from British Guiana :—♀ (*Rodway*); Essequibo R., Moraballi Creek, ♂ on trail, 12 Nov. '29, ♀ dark forest, 24 Sept. '29 (O.U. Exped.). The last-named specimen was detected by hearing the rustling sound the female made as she walked over dead leaves at the edge of the path, dragging a thick green caterpillar rather longer than herself. It was carried upside down, head foremost, being held by the jaws of the wasp only, gripped at the third pair of legs. It was dragged for fifteen feet, the wasp walking all the time. She then left it and circled about for one minute, visiting the nest which was twelve feet away. She then came back and fetched the caterpillar. During her progress she was quite silent, except for a slight buzz whenever she slipped. The caterpillar was laid down at the mouth of the burrow and she entered the nest to take out the temporary stopper. This was made of small bits of leaf, stick, and roots and was at a depth equal to her own length from the entrance. In clearing out the stopper, she flew with the pieces and dropped them about three feet away. She now seized the caterpillar by the prothorax and dragged it in. It became entangled with some projecting roots and the wasp came out and spent some time in vainly trying to tear the roots away. Finally she bit off their end portions and used them later for filling in the nest. The

burrow was half an inch in diameter, but excavation failed to discover the cell or the prey. The latter was perhaps a tailless Sphingid larva, green with red stripes at the sides.

3. *A. fragilis* Smith, 1856.

(= *pilimarginata* Cameron, 1912).

The type of Cameron's species, which was described from British Guiana, is preserved in the British Museum; it was compared with Smith's type.

Chlorion Latreille.

4. *C. viridicoeruleum* Lepeletier, 1825.

(= *hemiprasinum* (Sichel, 1863)).

Cameron (1912) recorded this species from British Guiana under Sichel's name. I have examined his specimen and also another collected by Rodway; both are females. Girard (1879 : 967) says that this species preys on cockroaches in the Antilles and Guiana.

Priononyx Dahlbom.

5. *P. thomae* (Fabricius, 1775).

I have examined one female of this species from British Guiana, N.W. District, Issororo, Aug. '17 (*G. E. Bodkin*).

The biology of *P. thomae* has been studied by Hartmann (1905 : 62), Williams (1913 : 227) and Rau (1918 : 175) in N. America and Panama. The species preys on large Short-horned Grasshoppers which she stores, one at a time, in cells at the end of a short burrow.

Isodontia Patton.

6. *I. costipennis* (Spinola, 1851).

I have examined the following specimens from British Guiana :—♂♀ (*Rodway*); ♂♀ N.W. District, Issororo (*G. E. Bodkin*); ♀ Essequibo R., Moraballi Creek, dark forest, 4 Sept. '29 (O.U. Exped.).

The insects of this genus always prey on Long-horned Grasshoppers and close the entrance of the nest with vegetable matter, often pieces of grass. The nest is apparently always in a ready-made cavity. Bristowe (1925 : 383) has published some notes on the habits of the present species in Brazil. A female wasp was seen depositing a Long-horned Grasshopper in a hollow bamboo. This was split open and found to contain three lots (*i.e.* cells) of grasshoppers, 7, 8 and 4 (the last probably incomplete) respectively. The groups were separated by wads of pappus and chewed vegetable matter. The wasp was closely mimicked by an Asilid fly, *Plesiomma fuliginosa* Wied.

Mayer and Schulthess (1923) describe the nests of this species brought back by Herr Zürcher from Paraguay. It is not recorded where the nests were situated, but they consisted of long cylindrical bags (5–8 × 1·5–2·5 cm.) woven of hairs from Apocynaceae or Asclepiadaceae. The cell inside one bag contained four or five nymphs of *Plemina* sp. (Tettigoniidae) and the cocoon of the wasp, a male of which emerged. *Chalcis* sp. emerged as a parasite.

In the British Museum is a nest of this species, the actual example mentioned by Smith (1859) as probably belonging to *Sphex lanieri*. Fortunately,

however, a male of *I. costipennis* bred from the nest still exists in the Museum collection. This nest is in a large curled-up leaf of which the tip is somewhat incurved at the bottom, partially closing the cylindrical cavity. The cigar-shaped object so formed is about 14 × 2·5 cm. The cavity had been filled from above with a dense packing of plant wool, almost certainly the pappus of a plant. On pulling the wool out, it was found that most of the wool in the top 4 cm. was closely wrapped round an empty cocoon; there was almost certainly another cocoon lower down, but this part of the nest was not disturbed. The small fragments of prey remaining were most probably those of a Tettigoniid.

The cocoon was cigar-shaped, rounded at both ends, 20 × 5 mm. The outer covering was of white, semi-transparent, wrinkled silk. Inside this was a light brown layer of smooth, parchment-like material.

A full account of the recorded habits of the species of this genus will be found in a remarkable paper by Piel (1933).

7. **Isodontia bastiniana** sp. n.

Allied to *I. nigrocoerulea* (Taschenberg, 1869) but the third antennal segment is longer than the fourth, which is as long as the fifth; the antennal segments, also, are without warts.

♂. Agrees in every particular with Kohl's description of *S.* (*I.*) *nigrocoerulea* (*see* Kohl, 1890 : 38) except :—Clypeus and legs, except trochanters beneath, entirely dark. Antennae with segment 3 very distinctly longer than 6, 4–6 subequal, no flagellar segment keeled beneath nor covered with warts (*i.e.* minute bristle-bearing tubercles). Fore femora flattened and somewhat concave posteriorly. Abdominal sternite 1 with a few long black bristles; sternites 2–5 with a little fine white tomentum and a few scattered, outstanding, black bristles, no rows of dense, outstanding, pale hairs; sternite 6 with a few short, outstanding, pale hairs; sternite 7 weakly emarginate with short, outstanding, reddish-brown hairs; sternite 8 deeply, subcircularly emarginate with dense, outstanding reddish-brown hairs. Length 18 mm.

Type, ♂, British Guiana, B.M. 1902–324 (purchased from Mr. Bastin).

Isodontia bipunctata described by Rohwer (1913) from Peru is stated to be black-haired, while the head and thorax have punctures of two sizes. In *I. bastiniana*, the hairs are white and only the bristles are black and the head and thorax are uniformly punctured.

Sphex Linnaeus.

8. *S. proximus* Smith, 1856, ♀.

(= ♂ *S. ruficaudus* Taschenberg, 1869).

I have examined the type of Smith's species, a female from "Brazil," and also the following specimens from British Guiana :—♂ N.W. District, Issororo, June '16 (*C. B. Williams*); 2 ♂♂ Mazaruni R., Kartabo, Aug. '22 (*M. D. Haviland*).

9. *S. funestus* Kohl, 1890.

This species was partly described from British Guiana (Demerara) and there is a female captured by Rodney in the collection of the British Museum.

10. *S. flavipes* Smith, 1856 var. *iheringi* Kohl, 1890.

I have examined one female from British Guiana :—Ituni Savannah, Cattle Trail Survey, May '19 (*A. A. Abrahams*).

11. *S. caliginosus* Erichson, 1848.

(= *S. erythroptera* Cameron, 1888).

A female from British Guiana from the Cameron collection is preserved in the British Museum. The museum also possesses a female, Tobago, Sept. '13 (*G. H. Sworder*), which is accompanied by its prey—*Idiarthron* sp. (TETTIGONIIDAE) (det. B. P. Uvarov).

12. *S. latro* Erichson, 1848.

(= *S. roratus* Kohl, 1890).

Dr. H. Bischoff has kindly examined Erichson's type and has established the above synonymy. Erichson's species was collected on the savannah of British Guiana by Schomburgk.

13. *S. fuliginosus* Dahlbom, 1843.

(= *S. congener* Kohl, 1890).

I have examined the following specimens from British Guiana :—♀ (*Rodway*); ♀ Essequibo R., Potaro, June '08 (*S. M. Klages*). Dr. H. Bischoff has kindly confirmed the synonymy by examination of the types.

14. *S. neotropicus* Kohl, 1890.

I have examined two females of this species from British Guiana :—Essequibo R., Moraballi Creek, 1 Nov. '29; Cuyuni R., Kamaria landing, 25 Nov. '29 (O.U. Exped.). Both were captured in camp clearings.

Howes (1919 : 68) gives what purports to be an account of the behaviour of this species in British Guiana. But there must be some confusion in his notes, since he describes the species as building mud-cells and preying on spiders.

15. *S. brasiliensis* Saussure, 1867 var. *tinctipennis* Cameron, 1888.

I have examined the following specimens of this species from British Guiana :—Essequibo R., Moraballi Creek, ♀ on trail 17 Sept. '29, ♀ burrowing near trail 24 Sept. '29 (O.U. Exped.).

The last-named specimen was heard buzzing as it jammed earth into the mouth of its burrow. The latter had been made in a very small patch of exposed sand amongst the dead leaves about four feet from the edge of a trail in dark forest. The significance of the buzzing of burrowing Sphecoids, which so often leads to the detection of insects which would otherwise be passed unnoticed, has been discussed by C. B. Williams (1921). It is probably only a necessary accompaniment of strenuous exercise. The burrow of the present female was about half an inch in diameter and went three inches downwards and then three horizontally. The end-cell contained five Long-horned Grasshoppers, of which four were immature. Some were still able to move their antennae.

16. *S. ichneumoneus* (L., 1758) var. *sumptuosus* Costa, 1862.

This species was recorded from British Guiana by Kohl (1890 : 432). I have examined the following specimens :—♀ Essequibo R., Monkey Jump, dark forest 9 Oct. '29 (O.U. Exped.); 2 ♀♀ 1 ♂ (near this variety) (*Rodway*).

Bodkin (1917) studied the species (presumably in the above variety) in British Guiana. The prey consisted entirely of nymphs or short-winged adults of grasshoppers. Poulton (1917) has recorded several observations on the prey of this species at São Paulo, S.E. Brazil. They consisted entirely of Long-horned Grasshoppers. The typical form of *S. ichneumoneus* has been studied in some detail in the United States, by the Peckhams (1898 : 33) and others.

Sceliphron Klug.

17. *S. fistulare* (Dahlbom, 1843).

This species is common on the coastal plain of British Guiana. I have examined one female—Georgetown, Botanic Gardens, Aug. '29 (O.U. Exped.). Bodkin (1917) has described its habits, which resemble those of other species of the genus. It makes mud-cells, attached to palings, houses, etc., and fills them with spiders.

Dynatus Lepeletier.

18. *D. nigripes* (Westwood, 1832).

(= *ingens* (Smith, 1847); ♂ = *crassipes* Cameron, 1912).

This species was recorded from British Guiana by Kohl (1902 : 32), and the type of Cameron's species, described from British Guiana, is preserved in the British Museum. I have also examined a female from British Guiana in the Cameron coll.

This is one of the largest of all known Sphecoids (length about 55–60 mm.). It might be expected to prey on large cockroaches, but Smith (1847) suggests that it preys on spiders, probably owing to confusion with large species of *Pepsis*. Like some species of *Podium*, it probably builds nests in, or on, wood. It would be very difficult otherwise to explain its introduction to Constantinople recorded by Fahringer (1921).

Podium Fabricius.

The species of this genus are mostly rare in collections, probably because they frequent forest rather than clearings and cultivated land (see remarks under *Trigonopsis*, p. 107).

19. *P. rufipes* Fabricius, 1805.

(= *P. biguttatum* (Taschenberg, 1869)).

Howes (1919 : 33) observed the habits of this species in British Guiana, at Kartabo. He found that it makes mud-cells attached to houses and stores them with cockroaches, four to a cell. Similar observations have been made by F. X. Williams (1928 : 127).

20. *P. angustifrons* Kohl, 1902.

I have examined one female from British Guiana :—Essequibo R., Moraballi Creek, on trail 27 Sept. '29 (O.U. Exped.).

21. *P. fumigatum* (Perty, 1833) var. *aurosericeum* Kohl, 1902.

I have examined one female of this species from British Guiana :—Essequibo R., Moraballi Creek, in swamp 25 Aug. '29 (O.U. Exped.).

Kohl (1902 : 58) has already recorded the species from "Guyana." F. X. Williams (1928 : 127) observed what was probably this species at Tena, Ecuador. It was gathering mud on a trail and is presumably a mud-dauber.

22. *P. denticulatum* Smith, 1856.

(= *P. brevicolle* Kohl, 1902; = *Trigonopsis longipilosum* Cameron, 1912).

Besides Smith's and Cameron's types, I have examined several more females from Cameron's collection from British Guiana. F. X. Williams (1928 : 127) found it gathering mud on the trail at Tena, Ecuador, together with the previous species, and Rau (1933 : 103) found the present species under similar conditions in Panama.

23. *P. goryanum* Lepeletier, 1845.

(= *P. foeniforme* Cameron, 1912 *nec* (Perty)).

I have examined a British Guiana female from the Cameron collection. Williams (1928 : 127) found it at Blairmont, British Guiana, and notes that it is a rare, sylvan species. Another female in the British Museum collection bears the following data :—"Blairmont, 17 Aug. '24, taken in the act of inserting a roach into a disused *Passalus* hole in a decaying stump of *Hora crepitans*."

24. *P. mocsaryi* Kohl, 1902.

I have examined one female from British Guiana :—Essequibo R., Moraballi Creek, gathering mud from trail 17 Sept. '29 (O.U. Exped.).

25. *P. luteipenne* (Fabricius, 1805).

(= *flavipenne* Lepeletier, 1825, and Kohl, 1902).

I have examined three females from British Guiana :—2 (*Rodway*) and 1 (Cameron coll.). F. X. Williams (1928 : 118) observed its habits in some detail at Blairmont. It makes burrows in the soil and stores up cockroaches, apparently in this locality always the nymphs of *Epilampra abdomen-nigrum* Degeer. An analysis of 153 cells showed that 40 contained 1 roach, 66—2, 33—3, 10—4, 4—5. The species is a partial mud-builder, since the burrows are plugged with a stopper of moistened earth.

It is still too early to classify the species of the genus *Podium* according to their biology. It may be noted that Kohl (1902 : 10), if *Dynatus* and *Trigonopsis* which I regard as separate genera are excluded, recognises five structural groups of *Podium*. The biology of some members of four groups is partly known, viz. *Parapodium* (*P. rufipes* = *biguttatum*) mud-dauber; group of *P. fumigatum* (*P. angustifrons*, *P. denticulatum* (= *brevicolle*), *P. fumigatum*) mud-gatherers, probably either daubers or cavity-users; group of *P. goryanum* (*P. goryanum*, *P. mocsaryi*) cavity-users, second species, however, only seen gathering mud; group of *P. luteipenne* (= *flavipenne*) (*P. luteipenne*, *P. dubium* Tasch. and *P. haematogastrum* Spin.) all burrowers. (The habits of the last two species are described by F. X. Williams (1928 : 124; 126).)

Trigonopsis Perty.

The species of this genus appear to be essentially forest-insects which are only rather rarely seen on the coastal plains or along the edges of rivers. Consequently they are rare in collections, and the Oxford University Expedition had an unusual opportunity to study them, being stationed throughout in forest areas. The number of specimens in the British Museum collection was almost doubled by the addition of the Expedition material.

Trigonopsis appears to be definitely "adapted" to forest life; the nests are made on tree-trunks or on leaves of trees, the latter habit being almost unique amongst Sphecoids (known also in some S. American species of *Trypoxylon*). The wasps sometimes even obtain water for nest-building from the axils of Aroids (see p. 110), though they have to descend to the ground to obtain mud for their nests and probably for their prey (cockroaches). The extraordinary triangular head, with a long, narrow neck behind the eyes, recalls the similar structure of some of the tree-haunting South American Carabidae (a group to which in general the habitat might be thought to be equally unsuited).

I have taken the present opportunity to make notes on all the species of the genus, since certain species described by F. Smith have not been recognised by other authors. Species not yet recorded from British Guiana are unnumbered in the text.

26. *T. affinis* Smith, 1851.

I have examined the following specimens of this species :—Brazil, ♀ type, Para; ♂ São Paulo : British Guiana, ♀ Essequibo R., Moraballi Creek (O.U. Exped.).

The species has also been recorded from British Guiana by Kohl (1902 : 36) and by F. X. Williams (1928 : 115) from Ecuador. The specimen obtained by the O.U. Exped. is a variety in which the three central clypeal teeth are larger than the lateral ones and the fore femora are black.

T. cyclocephalus Smith, 1873.

I have examined the following specimens of this species : Brazil, ♂ type, Ega; ♂ Villa Nova : Bolivia, ♀ (*J. Steinbach*).

The association of the Bolivian female with the males is necessarily very problematical until more material is available.

27. *T. intermedius* Saussure, 1867.

(*affinis* Kohl, *nec* Smith).

The following specimens have been examined :—British Guiana, ♀ (*A. W. Bartlett*), ♀ (*J. Rodney*), ♂ (Cameron coll.), ♀ Essequibo R., Moraballi Creek, 29 Aug. '29 (O.U. Exped.), ♀ same locality 22 Oct. '29 (O.U. Exped.). The last-mentioned specimen was carrying a cockroach up a hollow in a Mora tree. It may, perhaps, be suspected that the species is one that nests on tree-trunks.

28. **Trigonopsis moraballi** sp. n.

♀. Black; mandibles except the tips, and scape of antennae beneath, yellowish. Palpi reddish. Dorsal streak of fore tibiae, fore tarsi, and dorsal streak of mid tibiae, reddish. Abdomen, except petiole, reddish. Wings hyaline with dark bands across basal vein

(mcu_1) and across radial and third cubital and end of second discal cells. Pubescence silvery, short and dense on lower part of face, on procpisternum and fore coxae; forming bright silvery patches along posterior margin of pronotum, at mesopleural spiracle, at anterior end of mesosternum, along postero-ventral margin of mesopleuron, across post-scutellum and base of propodeum and on propodeum above each hind coxa. Length 20 mm. *Clypeus* with two strong triangular teeth between which lie four small but sharp ones. Part of head between the eyes about as long as the greatest distance between them. Pronotum smooth and shining, raised into a strong tubercle just before its posterior margin. Mesonotum smooth and shining with fine, very sparse punctures, disc weakly depressed. Mesopleuron shining with sparse, fine punctures. Furrow dividing off dorsal sclerite of mesepisternum moderately strong, but only weakly crenate. Lateral depressions of scutellum crossed by three strong keels. Metapleuron shining, sparsely punctured above, smooth below, ventral furrow separating it from metasternum rather weak, crenate. Pterostigma apically truncate. Dorsal surface of propodeum with a weak central keel situated in a furrow, dorsal surface strongly and regularly striate. Abdominal petiole one and a half times as long as dorsal furrow of propodeum, cylindrical, a little broader posteriorly, in lateral view nearly straight.

♂. Resembles the female except in the following particulars:—L. 18 mm. Orbits with a narrow yellow spot at level of clypeus. Fore tarsi dark. Clypeus with two strong teeth separated by a U-shaped emargination; teeth with their outer edges subparallel, distance between their tips only half the distance from the tip to the nearest point of the eye; distance from tip of tooth to bottom of emargination between them much less than that from bottom of emargination to level of lower edge of antennal sockets. Lateral depressions of scutellum crossed by only two keels. Abdominal petiole relatively a little longer. Abdominal sternites 4–6 with dense, modified tomentum. Abdominal sternite 7 triangular, strongly keeled.

Type, ♀, British Guiana: Essequibo R., Moraballi Creek, bred nest underside palm-leaf, 2 Sept. '29 (O.U. Exped.). Allotype, ♂, same locality, 13 Aug. '29 (O.U. Exped.). Paratypes, all from same locality, ♀ from same nest as type; ♀ nest on leaf of sapling, 3 Oct. '29; ♂ bred nest on leaf in clearing, 20 Sept. '29; further ♂ Brazil (B.M. coll.). The paratype, ♀, from the same nest as the type and the paratype captured on 3 Oct. '29, differ from the type in having a large, pale yellow spot on the inner orbit at level of the clypeus.

The following are some notes on the biology of the species.

Nest 1, found by Mr. N. Y. Sandwith on the underside of a leaf four feet from ground, 20 Sept. '29. There were two mud cells in contact, with their long axes parallel; size, outside 20 × 10 mm., inside 17 × 7 mm. The cells lay with one of their long sides attached to the leaf and with one end at the mid-vein. In one cell was a single, rather large wingless cockroach. It was distinctly alive and still capable of moving its legs and antennae. The egg of the wasp was white, slightly curved, 3 × ¾ mm. long, attached to the meso-sternum, just under the fore legs. The other cell contained three smaller cockroaches. Of the wasp larvae, one died and the other pupated on 29 Sept. and emerged during the journey home in October.

Nest 2, found by Mr. J. E. Duffield on the underside of a leaf of a sapling about six feet from the ground, 3 Oct. A single mud-cell, about 35 × 12 mm., was still open at one end. The cell broke on removing it from the tree and the prey were lost; there were two of them, almost certainly cockroaches. The wasp carried its prey with the aid of her mouth and fore legs.

Nest 3, found beneath a palm leaf, 2 Sept. It consisted of three cells and

produced two female wasps and one Bombyliid fly, *Anthrax leucopyga* Macquart ♂ (det. Dr. F. W. Edwards).

29. *T. violaceus* Smith, 1851.

(♀ = *resplendens* Kohl, 1902).

I have examined the following specimens of this species: type ♂ Brazil, Para; ♀ British Guiana, Essequibo R., Moraballi Creek, dark forest, 6 Nov. '29 (O.U. Exped.). Richards (1935) records the breeding of a parasite, *Pachyophthalmus floridensis* subsp. *antillarum* Rich., from a mud nest of this species in Trinidad, by Mr. D. Vesey FitzGerald.

T. cameronii Kohl, 1902.

(= *violaceus* Cameron *nec* Smith).

Kohl regarded this form as a variety of *T. abdominalis* Perty, but I think it must be given at least subspecific rank. I have examined the following specimens:—♀ Guatemala, Vera Paz, San Juan (*Champion*); ♀ Mexico, Tabasco, Teapa March (*H. H. Smith*); ♀ "Cananche" July. Kohl records it (1902 : 39) from Panama, Colombia and French Guiana. The male appears to be unknown. F. X. Williams reared the species (1928 : 115) from a mud-cell nest found at Bucay, Ecuador.

30. *T. abdominalis* Perty, 1833.

(? = *rufiventris* (Fabricius, 1805)).

I have examined the following specimens of this species: Brazil. 2 ♀♀ Para; 2 ♂♂ Villa Nova; ♂ São Paulo: British Guiana. ♀ (Brit. Mus. coll.); 5 ♀♀ 1 ♂ from one nest, Essequibo R., Moraballi Creek, 21 Aug. '29; ♀ same locality, 6 Sept. '29; ♀ from nest in same locality, 7 Sept. '29 (O.U. Exped.).

The following are some notes on the biology of the species. F. X. Williams (1928 : 115) published observations on the nesting-habits of an Ecuadorian wasp which he identified as this species. He noted, however, that it differed in certain particulars from specimens captured in Guiana. In view of the possibility that an undescribed allied species might well exist, I cannot refer his observations here with complete confidence. Both the nests he found were on the underside of palm-leaves, whereas the nests I found in Guiana were on trees.

Personal observations. Nest 1. Found at Moraballi Creek on the branch of a tree about four feet from the ground, 21 Aug. '29. There were six cells, 25 × 8 mm., lying side by side with their mouths upwards. While they were still being filled, the mouths of the cells have a definite rim and the outside of the cells still showed the individual pellets from which it had been built. The nest had four closed cells and two open ones. The nest was removed and later two wasps were found searching the site. One was without prey, the other carried a small adult cockroach in its mouth; the prey was carried in the wasp's mouth head foremost, upside down. Possibly the combined cell-mass may have belonged to two individuals. Prey taken from the unclosed cells still showed movements of the legs and antennae in the evening. The closed cells produced a male and three females in about three weeks' time.

Nest 2. The nest was found in the same locality on 7 Sept. '29, under the thick overhanging roots of an uprooted tree, about four feet from the ground.

It consisted of one cell finished and closed, two finished but open, and one in the course of construction. The earth was obtained from amongst the tree-roots just above the nest. Every two or three minutes the wasp flew off to get water, either drops from the surface of leaves or from the axils of the leaves of the Aroid, *Philodendron rudgeanum* Schott. (det. Mr. N. Y. Sandwith), which was climbing over the tree. The cell was built from above downwards, the rim or collar being constructed first. The wasp worked upside down, putting her head through the collar and building from the inside. The walls were made of a number of small pellets, placed side by side. On 8 Sept. there were two cells closed and three open. The nest was now accidentally destroyed by one of the other entomologists, who captured the wasp.

31. **Trigonopsis grylloctonus** sp. n.

♂. Black; mandibles pitchy; palpi, underside of scape and a minute linear spot on inner orbit at level of clypeus, yellowish. Femora with violet reflections, knees reddish. Abdomen, except petiole, reddish. Wings hyaline with dark bands across the basal nerve and across the radial, second cubital and second discal cells. Pubescence silvery, forming bright patches at the mesopleural spiracle, the lower posterior corner of the mesopleuron, the top of the metapleuron, on a transverse band across the anterior margin of the propodeum and on a patch on the propodeum above the hind coxae. Length 12 mm. *Clypeus* with two strong apical teeth, separated by a U shaped emargination. Part of head between the eyes one and a third times longer than the greatest distance between them. Pronotum smooth and shining, not raised into a tubercle posteriorly. Mesonotum raised on each side of the depressed disc, shining with large, very sparse punctures. Mesopleuron shining, almost unpunctured, furrow separating the upper from the lower part of the mesepisternum weak, unpunctured. The single keel crossing the depressions on each side of the scutellum very weak. End of pterostigma truncate. Metapleuron smooth, unpunctured, crossed by a keel which is a continuation of the strong posterior mesosternal border, but ventrally to this only separated from the metasternum by a weak, weakly crenate furrow. Dorsal surface of the propodeum with a central furrow which is crossed by regular transverse keels; longitudinal keel down centre of furrow (dividing two rows of punctures) only indicated. Dorsal surface smooth and shining with sparse scattered punctures, only punctate-striate laterally and posteriorly. Abdominal petiole moderately long, about one and two thirds times as long as dorsal furrow of propodeum, thickened in centre and thinner at each end, a little longer than the remainder of the abdomen, in lateral view little curved. Apex of sternite 7 rather deeply and subangularly excised, with a patch of dense pubescence on each side. Sternite 8 triangular, apex with a small patch of dense short outstanding pale pubescence, narrowly emarginate.

Type, ♂, British Guiana: Essequibo R., Moraballi Creek, nest on leaf of tree 25 Sept. '29 (wasp emerging later) (O.U. Exped.).

The following characters will separate this species from *T. abdominalis*:

T. abdominalis. Larger, length 17 mm. Apex of pterostigma not truncate. Furrow separating off top of mesepisternum strong, strongly crenate. Metapleuron with quite a number of large punctures and also, where it passes between mid and hind coxae, completely divided from metasternum by a strong crenate furrow. Petiole long and narrow, fully twice as long as dorsal furrow of propodeum, considerably longer than the rest of the abdomen, parallel sided, almost exactly cylindrical. Prey Blattidae.

T. grylloctonus. Smaller, length 12 mm. Apex of pterostigma truncate. Furrow separating off top of mesepisternum weak, not crenate. Metapleuron unpunctured and

also, where it passes between the mid and hind coxæ, not completely divided from the metasternum by a furrow, the incomplete furrow being only weakly crenate. Petiole shorter, distinctly shorter than twice the length of the dorsal furrow of the propodeum, hardly longer than the remainder of the abdomen, in dorsal view thicker at one third its length from base than at either base or apex, in lateral view distinctly thickened just before its middle. Prey Gryllidae.

In the preliminary sorting of material, this specimen was put down as a small specimen of *T. abdominalis*, but when the biological notes were examined, it was found that the prey in the nest was crickets. Later a number of small structural distinctions were noticed in the wasp.

The nest was found by Mr. N. Y. Sandwith on the underside of a leaf, attached to the mid-rib near the base. It was an ovoid mass of reddish mud, 30 × 20 mm. and 17 mm. deep (*i.e.* the cells had apparently been daubed over). One cell was still open; its internal diameter was 4 mm. and it contained a cricket. The type male emerged from the other cell in October, during the journey home.

The following key will assist in the separation of the species of *Trigonopsis*. One reputed species, *T. plesiosaurus* Smith, 1873, must be transferred to *Parapodium*. I have examined the unique type female, described from Ega, Brazil. The part of the head behind the eyes is much shorter than in *Trigonopsis* and there is no defined dorsal area to the propodeum. It is especially distinct in that the part of the head between the eyes is more than twice as long as broad.

Trigonopsis.

1. Prothorax posteriorly raised into an angular hump. Occipital keel forming a low collar. Scutellar depressions crossed by two or three keels. Dorsal surface of propodeum more or less distinctly striate . . . . 2.
— Prothorax posteriorly not angularly humped. Dorsal area of propodeum smooth or punctate, scarcely striate . . . . . 9.
2. Females . . . . . 3.
— Males . . . . . 6.
3. Small species. Clypeus with very large, parallel teeth, with three others one-quarter their size between them. Head beneath flat, occipital hollow very small, occipital keel ventrally fading out gradually. Sixth sternite strongly keeled. Clypeus largely yellow, antennæ pale beneath, fore legs red . . . . . *T. affinis* Smith.
— Resembles *T. affinis*, but three central clypeal teeth larger, and fore femora black . . . . . *T. affinis* (variety from British Guiana).
— Large species. Head beneath not flat but occupied by a rather large occipital hollow. Sixth sternite not keeled. Female clypeus different . 4.
4. Clypeus with four strong teeth and a weak central one. Occipital keel strongly raised at the points where it ends ventrally. Clypeus largely pale, antennæ black, mid and fore legs largely red. *T. cyclocephalus* Smith (?).
— Clypeus with a different arrangement of teeth. Occipital keel fading out gradually where it ends ventrally. Clypeus black, antennæ black, scape pale beneath, legs black, fore tibiæ and tarsi red-tinged . . . 5.
5. Clypeus with two very strong diverging teeth, the margin between them irregularly serrate, forming 4–6 weak teeth. Supra-antennal keel distinct. Larger, propodeum dorsally more closely and strongly transstriate . . . . . *T. intermedius* Saussure.

— Clypeus with two very strong parallel teeth with four small sharp ones between them. Supra-antennal keel obsolete or nearly *T. moraballi* sp. n.

6. Clypeus black, if a little reddish, then the tips of the teeth extensively black. Antennae black, scape pale beneath. Four front tibiae and fore tarsi reddish. (Outer margin of clypeal teeth little convergent, no small tooth outside them.) . . . . . 7.

— Clypeus considerably pale, at least the teeth entirely reddish. (Outer margins of teeth considerably converging.) . . . . . 8.

7. Larger; emargination of clypeus very broad and deep. Distance between tips of teeth about as great as that between one of them and nearest point of eye. Tooth longer than distance from bottom central emargination to lower edge of antennal socket. Base of teeth reddish. Propodeal striae stronger . . . . . *T. intermedius* Saussure.

— Smaller; emargination of clypeus smaller and narrower. Distance between tips of teeth much less than that from one of them to nearest point of eye. Tooth shorter than distance from bottom of central emargination to lower edge of antennal socket. Teeth black. Propodeal striae weaker . . . . . *T. moraballi* sp. n.

8. Outer margin of clypeal teeth basally emarginate, leaving a small tooth just lateral to each big one. Clypeus and teeth entirely pale yellowish. Antennae black, scape pale beneath. Four front tibiae and tarsi pitchy. Clypeal teeth and emargination almost as large as in *T. intermedius*. Small species . . . . . *T. affinis* Smith.

— No additional small teeth outside the big ones. Clypeus apically and the teeth reddish. Clypeal teeth and emargination more as in *T. moraballi*. Four front legs mainly and first three segments of antennae (except dorsal side of third) red . . . . . *T. cyclocephalus* Smith.

9. Abdominal petiole rather strongly curved upwards near its posterior end. Prothorax definitely convex in profile, sinking abruptly posteriorly though not angular. Sides of propodeum striate. Violaceous species with underside of scape pale.

♀ mandible and narrow apical band to clypeus pale yellow (or Trinidad specimen) clypeus violet. Clypeus with five teeth, central one small, outer ones not very large.

♂ mandibles pitchy, clypeus black. Clypeus very strongly triangularly produced, production truncate . . . . . *T. violaceus* Smith.

— Abdominal petiole nearly straight. Propodeum in profile almost quite flat. Clypeal teeth stronger and more of one size . . . . . 10.

10. Violaceous species. Striae of sides of propodeum more irregular and effaced. Legs entirely dark. Clypeus apically pale *T. cameronii* Kohl ♀.

— Black species with red abdomen (except petiole). Striae of sides of propodeum stronger.

♀ four front knees pale; clypeus apically pale.

♂ four front legs largely red; clypeus usually black, rarely apically reddish, produced into a pair of strong teeth separated by a U-shaped emargination . . . . . 11.

11. Larger, length 17 mm. or more. Petiole cylindrical, longer, twice as long as dorsal furrow of propodeum . . . . . *T. abdominalis* Perty.

— Smaller, length 12 mm. Petiole thickened in middle, shorter.
T. grylloctonus sp. n. ♂.

Bembecidae.

Parker (1929) has recently revised the species of this family and few taxonomic problems arise.

Rubrica Parker, 1929 (= *Monedula* auctt., in part).

1. *R. surinamensis* (Degeer, 1778).

I have examined the following specimens from British Guiana :—1 ♂ 5 ♀♀ Demerara, Mahaica, 15 Oct. '16. Parker (1929 : 55) also records the species from Georgetown.

Notes on the biology have been published by Poulton (1917), Lindner (1929) and Brèthes (1902). Lindner records that the Asilid, *Mallophora vegeta* Arribalz., preys on *R. surinamensis* in the Gran Chaco. Poulton records that the wasp preys on various Diptera at S. Paulo. Brèthes records that the species lives in rather numerous colonies on bare slopes and paths near Buenos Aires. The burrow is 10–12 cm. deep and leads to a horizontal cell, $1\frac{1}{2} \times 4$ cm. In absence the entrance is always closed. The prey is Diptera belonging to many families, including Stratiomyiidae, Tabanidae, Bombyliidae, Nemestrinidae, Asilidae, Syrphidae, Tachinidae and Muscidae. The egg is laid on a moderate-sized prey, on the wing near the calyptra. The larva spins a date-shaped cocoon of earth and silk with a fine silk lining. The head end is rounded and the other one pointed and there is always a small protuberance near the middle. Its dimensions are 1×3 cm.

The male recorded above from Mahaica emerged from a cocoon which is brown, stiff, parchment-like, cigar-shaped, narrowed at each end; dimensions 8×30 mm.

Engel (1936) records that Lindner bred the Bombyliid, *Hyperalonia morio* (Fabr.) from a nest of *R. surinamensis* in the Gran Chaco.

Stictia Illiger, 1807 (= *Monedula* auctt. in part).

2. *S. signata* (Linnaeus, 1758).

I have examined the following specimens from British Guiana :—3 ♀♀ Essequibo R., Moraballi Creek, 30 Aug. '29, 16 Sept. '29, 28 Sept. '29; Essequibo R. first falls, 2 ♀♀ 10 Sept. '29, 2 ♀♀ 14 Oct. '29; ♀ Essequibo R., Monkey Jump, 27 Oct. '29; ♀ R. Essequibo, river bank, 15 Nov. '29; Cuyuni R., Kamaria Landing, 3 ♀♀ 22 Nov. '29, 1 ♀ 23 Nov. '29 (O.U. Exped.); ♂♀ Mazaruni R., Nov. '16 (*Bodkin*); 2 ♂♂ Demerara. Parker (1929 : 27) records it also from British Guiana (9 April '01).

Bates (1876 : 182) found *S. signata* nesting on the banks of the Upper Amazons. It preyed on Tabanids, including *Lepidoselaga* (*Hadrus*) *lepidota*, sometimes catching them on the observer. The prey were tightly held against the underside of the thorax by means of the fore and mid feet. Bates describes the orientation-flight of the wasp when memorising its nesting-site. Neiva and Penna (1916 : 114) also record Tabanids as prey in Brazil.

Howard, Dyar and Knab (1912 : 171) record an interesting observation on the use of mosquitoes as food by the adults of this wasp. At Calapatch Is., near Cuba, Mr. H. J. Browne found the adults eating yellow-fever mosquitoes almost exclusively; they were seized and devoured on the wing. One wasp was seen to eat twenty in five minutes. This observation is, perhaps, unique; several fossorial wasps (e.g. *Mellinus*) are known to eat part of their prey, but the large-scale catching of prey of a special type unsuited to storage for the larva is not recorded elsewhere.

In British Guiana, *S. signata* appears to be essentially a river-bank species, nesting in sands which are submerged in the wet season. Such was its nesting-site at the first falls of the Essequibo R., where it was abundant on

small sandy islands in the middle of the river. At Moraballi Creek, where a moderately large clearing was made for camping, the wasps arrived and started nesting after about three weeks. On 12 Sept., two females were seen burrowing on a small sandy patch. They quarrelled a good deal with one another and one female several times investigated the other's nest. They were very shy of observation, especially of any movement by the observer. The burrows were initially horizontal, about half an inch in diameter. On the following day, one of the wasps was seen to return to its nest in the afternoon. In its absence, the entrance had become covered by dead leaves. Small pieces of leaf and root were lifted and carried several feet in the air and dropped. A larger leaf was dragged aside. One leaf was deeply embedded in the sand and could not be moved. The female attempted to burrow under one side of it, but she appeared very uneasy. She repeatedly flew two or three inches into the air to reorientate and made repeated attempts to drag the leaf away, but it broke in her jaws. Rain now began and she flew almost at once high into the air, probably to shelter in a tree. On 16 Sept., one of the wasps was caught with prey, a Muscoid fly. This was held so tightly against the underside of the thorax that it was hardly visible. When the nest was completed, the female filled it in with sand, which was rammed down with the tip of the abdomen (*cf.* Carpenter, 1930 : 300).

On several occasions small flies were seen standing near the burrowing females of *S. signata*. The flies were often perched on some projecting stick giving a good view of the burrow and they returned if they were frightened away. One female was identified as *Oscinella columbiana* End. by Dr. O. Duda. It is probable that this fly lays its eggs amongst the prey of the wasp, though such habits have not previously been recorded in the genus.

3. *S. pantherina* (Handlirsch, 1890).

I have examined one British Guiana female of this species—Demerara (*Harper*), Cameron coll.

4. *S. maculata* (Fabricius, 1805).

There is some difficulty in separating this species from *S. andrei* Handl. Parker tabulates them as follows :—

Scutellum lacking pubescence, very finely punctured with a few scattered larger punctures; labrum yellow; discal stripes on the scutum narrow. *andrei*
Scutellum pubescent (at least at sides), uniformly and rather coarsely punctate; labrum with black central stripe; discal stripes on scutum broad. *maculata.*

In my opinion the presence or absence of short black pubescence on the scutellum is the best diagnostic character. In the material I have examined (all females, except two males of *S. maculata*), the two species work out as follows :—*maculata* (7 ♀♀) has pubescence on the scutellum, a black mark on the labrum (except for one specimen) and all the tarsi distinctly annulated with black. *andrei* (5 ♀♀) has no pubescence on the scutellum, the labrum yellow and the tarsi entirely yellow.

S. andrei has hitherto been recorded only from Peru (Handlirsch described 3 ♂♂, 21 ♀♀, while Parker saw 2 ♀♀). When defined as above, *S. andrei* seems to be nearly as common in British Guiana as *S. maculata*. I have seen the following specimens of *S. maculata* from British Guiana :—1 ♀ (*Rodway*)

(almost no black mark on clypeus); 2 ♀♀ Moraballi 23.ix.29; ♀ Moraballi 18.viii.29; ♀ Moraballi 24.ix.29; ♀ Moraballi, Wallaba Bush, 7.xi.29; ♀ Cuyuni R. Kamaria landing 25.xi.29.

Habits not known.

5. *S. andrei* (Handlirsch, 1890).

Besides one female from Peru, Nauta (det. Handlirsch), I have examined the following females from British Guiana :—♀ R. Mazaruni Nov. '16 (*G. E. Bodkin*); ♀ Monkey Jump 9.x.29; ♀ 1 m. N. of Monkey Jump 14.x.29; ♀ Moraballi 14.xi.29; ♀ Moraballi 15.xi.29.

Bicyrtes Lepeletier, 1845 (= *Bembidula* Burmeister, 1874).

6. *B. discisa* (Taschenberg, 1870).

I have examined the following specimens of this wasp from British Guiana :—2 ♀♀ (*Rodway*); ♀ Mazaruni R. (*G. E. Bodkin*); Essequibo R., Moraballi Creek, ♂ 9 Sept., ♀♀ 1 Sept., 5 Sept., 9 Sept., 17 Sept.; Essequibo R., Monkey Jump, ♀ nesting in sand, 11 Oct. '29 (O.U. Exped.).

All the specimens were captured in small clearings, where the sun could get at the soil and the solitary nests were always in sand (three observed). The female was twice caught with prey (9 Sept., 17 Sept.), in both cases an immature Pentatomid nymph. Brèthes (1918) found *B. discisa* nesting in a bank at the edge of a sandy path near Buenos Aires. The burrow consisted of a short oblique gallery at an angle of 45°, 10 cm. long, followed by a horizontal portion leading to a cell. The prey were nymphs of *Edessa meditabunda* L. (Pentatomidae) and *Spartocerus brevicornis* Stål and *Pachylis argentinus* Berg. (Coreidae)

7. *B. odontophora* (Handlirsch, 1889).

I have examined the following specimens of this species from British Guiana :—Essequibo R., Moraballi Creek, ♂ 12 Sept. '29; Monkey Jump, ♂♀ 7 Oct. '29, ♀ 14 Oct. '29 (O.U. Exped.).

8. *B. variegata* (Olivier, 1789).

(= *Bembex guyana* Cameron, 1912).

I have examined the following specimens of this wasp from British Guiana :—♀ (type of *guyana* Cameron); ♀ (*Rodway*); Essequibo R., Monkey Jump, 2 ♀♀ 7 Oct. '29 (O.U. Exped.). Parker (1929 : 174) records it from Essequibo R., Bartica. Poulton (1917) notes that the prey in Brazil is immature Pentatomids. Claude-Joseph (1928 : 119) has described the habits in greater detail in Chile, where it also nests in sand on the edge of rivers. A number of cells lie at the end of short galleries leading from a central burrow, the cells nearer the surface probably being made first. The cells actually lie between 1–2 and 10–15 cm. below the surface. The nest is closed by the sand during the wasp's absence. The prey all belonged to the large bug, *Leptoglossus* (*Anisoscelis*) *chilensis* Spin. (Coreidae), both adults and nymphs.

Microbembex Patton, 1879.

9. *M. sulphurea* (Spinola, 1853).

I have examined the following British Guiana specimen of this species :—♀ Mazaruni R., Penal Settlement, 13 Sept. '16 (*Bodkin*).

Claude-Joseph (1928 : 113) and (1929 : 418) has described its habits in Chile. It nests in sand, making a short gallery at the end of which are several cells. The entrance of the nest is closed while the female is foraging. The prey is extremely varied, including *Galeodes* (Arachnid), beetles, Diptera, Homoptera, dragonflies and Hymenoptera. Its predatory habits thus resemble those of the well-studied *M. monodonta* (Say) which gathers dead insects or fragments of insects of all kinds from the surface of the soil. Claude-Joseph suggests that the prey are paralysed in the ordinary way, but it is, perhaps, more probable that they are collected dead as in *M. monodonta*.

The males of *M. sulphurea* spend the night in small burrows in the sand.

Bembecinus Costa, 1859.

10. *B. cingulatus* (Smith, 1856).

(= *Larra agilis* Smith, 1873; = *Bembidula ornaticauda* Cameron, 1912).

I have examined the following British Guiana specimens of this species (besides Smith's two types) :—♀ (Cameron coll.; type of *ornaticauda*); 6 ♀♀ Essequibo R., Moraballi Creek, 9 Sept., 11 Sept., 3 12 Sept., 13 Sept., 21 Sept., '29 (O.U. Exped.); 8 ♀♀ Essequibo R., Monkey Jump, 2 7 Oct., 8 Oct., 2 9 Oct., 10 Oct., 2 14 Oct., '29 (O.U. Exped.).

The females of this species were rather common at Moraballi Creek, nesting in small patches of exposed sand in the camp clearing. A short burrow was constructed, leading to a cell a little way below the surface. The nest examined in detail consisted of one cell only, but possibly, if not interfered with, additional ones would have been constructed. While the female is away hunting, the entrance of the burrow is filled in with sand. The prey consist of Jassidae, either nymphs or adults. A female with prey was caught in the net, where she dropped her victim. They were put together in a glass tube. After struggling to escape for a time, she seized the prey, dorsal side uppermost and heads in the same direction, bent her abdomen round and stung it on the underside of the thorax. She then walked for a time carrying the prey in the same position, held by her mid legs. Specimens carrying prey to their nests, however, carry them upside down with the heads in the same direction. A female was seen filling in her burrow, carrying sand to it and pressing it down with her abdomen. This burrow was excavated and was found to contain two mature and two immature leaf-hoppers (*Ponama* sp.) and a wasp-larva three millimetres long. This suggests that the larva is fed after it has hatched, as in *Bembix*.

These observations suggest that the habits of *B. cingulatus* are extremely similar to those of the type-species of the genus, the European *B. tridens* (Fabricius), as described by Ferton (1908 : 554). In that species, also, progressive provisioning is recorded.

The following Homoptera were found as prey of *B. cingulatus* at Moraballi Creek :—*Cicadella* sp. 1 ♀ 3 nymphs; *Oncometopia* sp. 4 nymphs; *Dichrophleps* sp.; *Ponama* sp. 1 ♀ and 1 nymph; *Homalodisca* sp. 1 ♀. In the case of the nymphs the generic position is only approximate. The determinations are due to the kindness of Mr. W. E. China. In the British Museum collection there is further a female of *B. cingulatus* from Panama—Almirante, 7 Feb. '17 (*C. B. Williams*)—with its prey, *Ponama* sp. ♂ (det. W. E. China).

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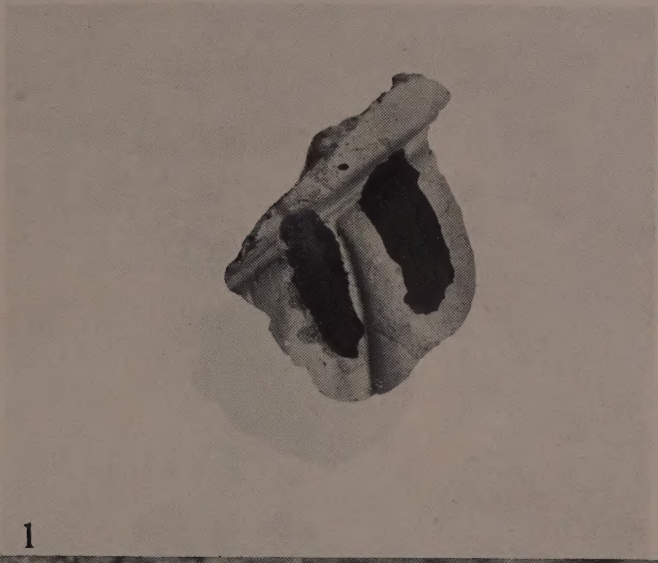
Plate 1.

Fig. 1. Two-cell nest of *Trigonopsis moraballi* Richards. The surface which was attached to a leaf has been photographed. (Photo. J. E. Duffield.)

Figs. 2–3. Two views of the female of *Stictia signata* (L.) at the entrance to her nest. (Photo. J. E. Duffield.)



1

2

3

ENGRAVED BY STAR ILLUSTRATION, LONDON.

Nest of *T. moraballi* and female of *S. signata* entering her nest.